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ABSTRACT

Presented is a plan for curriculum development and evaluation which leads to involvement of public and private schools and the community in environmental education for the spectrum of citizens from children through adults. The process is described in two phases: (1) the overall program, and (2) an evaluation of a pilot implementation of segments of the program in selected grades of school. Statistical analysis of the effects of the program on student attitude and achievement are described along with supporting discussion and conclusions. (PE)

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IMPLEMENTING ENVIRONMENTAL EDUCATION IN THE SCHOOL CURRICULUM

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by

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(Virginia Beach, Virginia)

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IMPLEMENTING ENVIRONMENTAL EDUCATION IN THE SCHOOL CURRICULUM

Even at the turn of the century, conservationists had begun to be alarmed by the lack of public awareness concerning ecological imbalances and man's impact on the environment. As the century progressed through periods of astounding technological advances, the evidence that man's impact and the public's lack of understanding of what the American life style has taken from the environment has been overwhelming. As a nation enjoying one of the highest standards of living in the world, and as one that has generated many life-saving, labor-saving devices, the lack of action to prevent the destruction of natural resources and the vast disruption of the environment is indeed ironic.

In A World Traveler's View, Wilhelmina Hill credits Mr. A. D. Scott with this comment:" . . . a consideration of pollution that is more important is pollution of the mind, caused by an overemphasis on technological advances for which people might not be ready to control or use effectively."[1] Therefore, if there is to be a change in public awareness of and commitment to ecological balances, there must be a step toward values clarification and positive decision making by the public. Educators have been handed a major share of this massive educational process which must be accomplished. Environmental education within the educational system has been seen by individuals as a science of survival, of social values change, and a common sense 'need to know' subject for everyone. Nationwide, educators have begun to approach the problem.

What is recorded here is one school division's efforts to confront this major educational problem and progress positively toward the goal of an aware and informed citizenry. The major goals of this program are to increase public awareness and concern for the environment, to increase teacher knowledge of environmental

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concerns, and to increase student knowledge and awareness. To accomplish these goals, the program was designed to be implemented in three phases, which coincided with three consecutive school years (1977-78, 1978-79, and 1979-80).

INTRODUCTION

Virginia Beach, Virginia is a city of environmental contrasts. Within its boundaries of 38 miles of ocean and bay beaches is a city of 310 square miles and a population of 273,386 people. The city has experienced rapid growth during the past decade, with approximately 800 - 1,000 people settling in Virginia Beach each month. It is recognized as the third fastest growing city in the United States.(2)

Agriculture, tourism and government are the major industries. A combination of unique natural settings which include Atlantic Ocean and Chespeake Bay beaches, tidal flats, wetlands, Back Bay National Wildlife Refuge, and Seashore State Park are located within city boundaries. The city has also received national recognition for an environmentally unique phenomena, Mount Trashmore, a man-made park constructed on a city landfill area. The 50 acre park began as an innovative solid waste disposal project. The building materials were layers of solid waste interspersed with layers of dirt and topped with a final six-foot layer of soil. The resulting mountain towers 68 feet in a region of normally flat terrain. When the landfill project was completed, the area was converted into a park which contains a 5,000 seat amphitheater, soap box derby ramp, foothills, large freshwater lake, skateboard and slalom course, and tennis courts.

Local Environmental Conditions

During the past few years the residents of Virginia Beach have witnessed a series of environmental changes which have affected the quality of life in the area. Shellfishing in various areas has been banned due to sewage contamination

of waterways. The recent discovery of the pesticide Kepone in the fish and shellfish found in local waters has served to indicate the severity of environmental abuse. It is not uncommon to find shore birds with pop-top tabs caught in their throats or the six-pack plastic holders looped around their necks and occasionally, the carcass of a sea turtle washes ashore with a discarded plastic bag lodged in its throat.

Rapid development of the area has taxed the clean water supplies, produced high levels of sedimentation in local waterways, added to the problems of sewage and solid waste disposal, and increased vehicular traffic, which concurrently increases the amount of air pollutants. There has been significant loss of valuable wetland areas. Development without concern for the loss of vital areas has affected the quality of water, caused loss of nursery areas for a large percentage of ocean life, and resulted in loss of habitat for varied animal life.

It appears that local citizens do not understand or appreciate the need for maintaining a stable dune system along the beaches as evidenced by the heavy traffic across the dunes. Research indicated that there is a need to educate citizens about the value of the dunes and how to build and maintain a dune system.

The list of environmental concerns for this rapidly growing coastal city is large and continues to grow as the city develops, port facilities expand, and oil companies look to the area as a potential refinery site. Therefore, the need for a concerned and educated citizenry is mandatory.

As a result of a needs assessment, it was apparent that major categories of needs exist.

1. There was marked lack of concern for environmental problems in the area. Therefore, the need to educate teachers, students, and the public about the problems was pressing.

2. There was no need for educational programs not presently available within the system. There were teachers within the system who incorporate ecological units into the existing curriculum. Seventh grade science concentrates on ecological topics, but there was no formal program which emphasized the quality and preservation of the environment.

3. Results of standardized state administered tests had shown weaknesses in existing programs in the area of environmental education.

4. Teachers must receive adequate training in content and methods of incorporating ecological and environmental topics into the existing curriculum.

Problem

Previously, no environmental program had been established to inform the public as to its responsibility in protecting and appreciating the unique environmental "phenomena" of the region. It was determined that the development of awareness among not only the students of Virginia Beach, but the entire community would be the most positive approach toward conserving and improving the environment. Through this program, the Virginia Beach City Public School Division has created an atmosphere in which individuals can develop positive attitudes concerning environmental problems.

Project ICE was designed to meet certain needs within the school system. The general environmental education needs of the Virginia Beach area were determined by:

1. The requirements of the State Department of Education's Standards of Quality

2. The results of the self-studies of the local elementary schools

3. The results of the self-improvement plans of the local secondary schools
4. The present condition of the local environment
5. Professional interest of local educators

These needs were selected for development because of the deficiencies in the educational areas mentioned and because these needs could be realistically met.

PHASE ONE

The first year was a planning year. Objectives for teacher training were developed to meet the program needs. Courses were designed to meet the specific objectives and were developed by ecology professors of the College of William and Mary.

The College provided six graduate semester hours of instruction designed to meet the environmental and educational needs of Virginia Beach teachers in the following areas:

1. Ecological and environmental topics
2. Instructional methods for developing and incorporating materials into the existing curriculum
3. On-site field activities stressing methods of monitoring local environmental conditions

In conjunction with the on-site field activities, the teachers received instruction in the geological history of the Virginia Beach area as a base for understanding both the natural and man-made changes that have occurred. They were instructed in the specific characteristics of each area so that on-site activities for both teachers and their students would be instructional and meaningful. Within each of the unique natural areas, ecological balances were

studied. In addition, the course work included information about the events which have brought about imbalance or changes within these systems. Teachers and students, therefore, are able to understand how the current state of the environment developed.

Since it is believed that the quality of life is dependent on the condition of the physical environment, the courses were taught by professors of geology, biology and education. The teacher training included classwork, laboratory experimentation and two weeks of actual field work for eight hours each day. During the remainder of the summer, teachers from this trained resource corps developed curriculum guides to be employed in their classrooms.

Thus, the corps of volunteer teachers served as the School Division's foundation for placement of a qualified teacher within each project school. These resource teachers have served to train other teachers within their schools.

Voluntary participation is identified below:

Type of Schools	Number of Schools in the System	Number of Schools Participating in the program
Senior High	8	8
Junior High	7	6
Intermediate	2	2
Elementary	39	24
Private	7	2

Community

Community involvement is an important part of the experimental program. Three facets of the program involve community members.

First, a list was compiled of community members who have skills or knowledge in topics related to ecology or environmental concerns and who would serve as guest lecturers or demonstrators within the schools.

Second, a volunteer task force of interested parents was created to assist teachers on field activities and to contribute skills such as typing.

Third, the program staff provided training for groups such as PTA or civic league members who would like to become involved in an environmental education program for themselves. This was accomplished by offering community informational workshops to apprise community members of information discussed in the schools. Global ecological problems are discussed; however, the workshops mainly stress local environmental problems and their probable causes and solutions. In addition, field trips to areas such as the wetlands and other natural environmental sites are also provided.

PHASE TWO

The second year of the program was the actual classroom implementation phase. The target grade levels were grades four, seven, and ten.

At grades four and seven environmental studies were incorporated into the existing science curriculum. At the tenth-grade level the course Ecology was developed. Each course is designed to provide students with an understanding of the interrelationships of living organisms and their physical environment. With this understanding, the effects of changes within the physical environment on these living organisms is introduced. Through this approach students would gain an understanding of why the condition of living organisms is truly dependent on the condition of the environment. Changes to the environment caused by man's impact through the management of natural resources (whether beneficial or careless) and the introduction of contaminants into the environment is studied in depth.

Students at all three grade levels are involved in activities designed to stimulate values clarification and decision making processes. Field activities, which include the monitoring of local environmental conditions, are stressed. In order to facilitate this aspect of the program, the School Division converted

a school bus into a mobile ecological research laboratory. The bus carries equipment necessary for conducting on-site tests and collecting specimens of plants and animals and soil sampling.

The program provides career information in environmentally related areas to students through the use of multi-media presentations, guest lecturers, and field trips to businesses and organizations related to environmental concerns. Additionally, students study the purposes of various organizations which are actively involved in the preservation of a quality environment, e.g., The National Wildlife Federation, The Nature Conservancy, The Audubon Society, The Wetlands Board, and The U. S. Fish and Wildlife Service, etc. Lists of organizations concerned with environmental policies and decisions are provided to all schools. In addition, Community Resource personnel and Community Task Force members have become actively involved in all phases of program development and implementation.

The program activities also serve to reinforce the basic learning skills of the students. Reading skills have been developed by the use of the basal text and media publications, such as newspapers and magazines. Mathematics skills are developed, strengthened and used constantly in laboratory and field activities. The understanding and interpretation of volumetric and linear measurements are necessary parts of this type of instruction and are thoroughly practiced. Verbal and written communication between students is stressed; therefore, it is anticipated that increased communicative skills by students will be noted.

In order to determine the effect of formal environmental studies on students at these grade levels, certain measurements were developed and administered. An attitudinal survey was administered to students in grades four and seven, while both an attitudinal survey and a content test were administered to students in the tenth grade.

Student Achievement

As indicated in the Measurement Planning Matrix (Table 1), a locally developed achievement test was to be developed and to be administered at the beginning and again at the end of the 1978-1979 school year. The purpose of the pretest-posttest administration of the achievement test was to determine the overall knowledge gain as well as the knowledge gain in the various content areas as they relate to environmental concerns. An achievement test was developed only for the 10th grade students because there was not an universally prescribed environmental curriculum for grades 4 and 7. For these latter grades, curriculum units were made available to the teachers and the teachers selected the units that best fitted into their science curriculum. Therefore, since there was some degree of flexibility in the curriculum for grades 4 and 7, no uniform achievement test could be developed.

The development of the achievement test for the 10th grade students began by reviewing the objectives for the course "Ecology". The objectives were initially defined and presented in the Project ICE Final Evaluation Report for the 1977-1978 school year. These objectives were subsequently revised; the revised objectives are found in the 1978-1979 Self-Evaluation Report. Following the revision of the objectives, test items were written that reflect these objectives. Thus, this portion of the developmental process was conducted to insure the content validity of the test. Relative to the reliability of the test, the Kuder-Richardson Formula 20 was computed on both the pretest and the posttest. The KR-20 for the pretest was 0.5577; the KR-20 for the posttest was 0.6877. (A copy of the test will be provided upon official request.)

The results of the pretest-posttest administration of the achievement test for the 10th grade students are summarized in Table 2. The mean achievement score on the pretest was 47.553; the mean achievement score on the posttest was 73.243. This gain of 25.69 was statistically significant ($t = 21.638$, $p < .0001$).

Table 1

Measurement Planning Matrix

Measurement Procedures	Evaluation Questions					
	#1	#2	#3	#4	#5	#6
A. Pretest and posttest of student achievement and student attitude	-determine the overall knowledge gained as well as knowledge gained in the various content areas	-determine the change in student attitude toward ecological and environmental concerns				
B. Student and teacher subjective evaluation at the end of the school year		-determine the most relevant and most enjoyed elements of the project	-determine the most relevant and most often used instructional units -determine teacher needs for subsequent years of the project			
C. Log of instructional components			-determine what kinds of instructional activities were used most often -determine the amount of time spent in each type of activity			
D. Subjective evaluation of inservice activities				-determine the effectiveness of the inservice activities -determine what inservice activities are necessary in the future		
E. Management files		-Number of extra class activities in which the students participated	-Number of students and teachers participating in the various components of the project	-Number and types of inservice activities	-Materials purchased -Materials used -Materials needed	-Nature of dissemination activities -Types of community involvement

Evaluation Questions

1. What impact does Project ICE have upon student achievement, the target students in grades 4, 7, and 10? What are the specific content areas in which the students exhibit an increase in knowledge gained?

2. What impact does Project ICE have upon student attitude of the target students in grades 4, 7, and 10? Is a positive attitude toward the Project ICE reflected in intra-class activities of the students?

3. What are the more important instructional components of Project ICE? Which of the instructional units are used most often by the teachers in Project ICE? What additional instructional units were used by the teachers? Which of the instructional units need revision or refinement?

4. What kinds of inservice activities were available to the teachers during the second year of Project ICE? What did the teachers indicate to be the positive and negative aspects of the inservice program? What additional inservice activities would benefit the teachers?

5. What materials in either the school libraries or the curriculum and research library were used most often? What additional materials are needed?

6. How were the project activities disseminated? To what audiences were the dissemination oriented? Did this dissemination increase the community awareness and involvement? What additional dissemination activities would enhance the community involvement?

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TABLE 2

Achievement Test Results for the Students in the 10th Grade Ecology Course

Pretest		Posttest	
Score	Frequency	Score	Frequency
95	1	95	16
90	0	90	20
85	3	85	72
80	4	80	36
75	12	75	28
70	17	70	40
65	22	65	37
60	24	60	28
55	34	55	20
50	42	50	0
45	40	45	0
40	47	40	8
35	24	35	4
30	33	30	0
25	11	25	0
20	11	20	0
15	2	15	4
10	1	10	0
5	0	5	0
0	1	0	0

$\bar{X}$ = 47.553
s = 15.367

$\bar{X}$ = 73.243
s = 14.723

t = 21.638 $p < .0001$

Student Attitude

Also, as indicated in the Measurement Planning Matrix, attitude instruments for grades 4, 7 and 10 were to be locally developed for the purpose of determining initial attitudes of students relative to environmental concerns as well as to determine changes in attitude as a result of their exposure to the Project ICE Curricular units/Ecology course. The developmental process was similar to that for the 10th grade achievement tests, i.e., the questionnaire items were based upon the objectives of Project ICE for the respective grade levels. The questionnaires are quite similar in content but the wording of the items vary due to the need for differing reading levels. Table 3 provides a copy of the tenth grade attitudinal questionnaire.

Since it was deemed inappropriate to sum the responses across the items to determine a single attitude score, each questionnaire item was evaluated individually. For grade 10, there was no control group; therefore, the analysis is based upon the change from pretest to posttest. For grades 4 and 7, there was a control group; therefore the analysis used was the Analysis of Crossbreaks. In this analysis, the difference between the ICE students and the control students were investigated for both pretest and posttest. Subsequently, the differences between the pretest and posttest were investigated for both the ICE students and the control students. These data are presented and discussed on the following pages.

As Table 4 shows for the 10th grade students who were enrolled in the Ecology course, a statistically significant change in attitude was found for only two of the sixteen statements on the environmental questionnaire. These two statements are numbers 3 and 7. As can be seen, these two statements are highly related and the change from pretest to posttest was the same. The data indicate that the students enrolled in the Ecology agreed that better mass transportation systems need to be developed and that there is a need to decrease the use of the automobile as the primary means of transportation.

TABLE 3

Teacher _____

Student _____

Date _____

DEPARTMENT OF INSTRUCTIONAL SERVICES

ENVIRONMENTAL QUESTIONNAIRE
FOR
TENTH GRADE ECOLOGY STUDENTS

Please consider the following 16 statements and indicate the extent you agree or disagree with each by circling the appropriate number in the response column to the right of the statement. There is no right or wrong answer. Your response indicates only your opinion.

STATEMENT	RESPONSE			
	Strongly Agree	Agree	Disagree	Strongly Disagree
1. You can increase the standard of living for all people without affecting the quality of the environment.	4	3	2	1
2. Most people in Virginia Beach are concerned about local environmental problems.	4	3	2	1
3. We need to decrease the use of the automobile as the primary means of transportation because it is a major cause of pollution.	4	3	2	1
4. One of the greatest threats to the future of this country is over-population.	4	3	2	1
5. People should help pay the cost of cleaning up the air that has been polluted by public utility companies.	4	3	2	1
6. Preserving the oceans, forests, streams, and other natural resources is more important than increasing the standard of living.	4	3	2	1
7. The government should provide better mass transportation systems, rather than constructing bigger and better highways.	4	3	2	1
8. The water used by industries and communities should be cleaned of all pollution before it is returned to its source.	4	3	2	1
9. To ensure the wealth and safety of humans, domestic animals and wildlife, we must stop using herbicides and pesticides even though this will result in poorer crops.	4	3	2	1
10. After I have become aware of an environmental problem, I usually look up information about the topic.	4	3	2	1
11. To decrease the litter problem, the use of nonreturnable bottles and cans should be prohibited.	4	3	2	1
12. Each individual is just as responsible for environmental pollution as are industries, power plants, and steel mills.	4	3	2	1
13. Every high school student should be required to take a course in environmental studies.	4	3	2	1
14. Because they are being depleted, energy substitutes should be developed for minerals and fossil fuels (for example: oil, coal, and natural gas).	4	3	2	1
15. I do not purchase products which are hazardous to the environment.	4	3	2	1
16. To conserve energy, people should be required to join carpools or use public transportation.	4	3	2	1

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TABLE 4

Response Frequencies for the Grade 10
Environmental Questionnaire

Statement	Test	Strongly Agree	Agree	Disagree	Strongly Disagree	χ^2
1	Pretest	20	126	134	43	7.41
	Posttest	22	97	118	62	
2	Pretest	22	107	154	40	7.21
	Posttest	30	118	129	24	
3	Pretest	68	134	86	33	16.87*
	Posttest	102	117	50	32	
4	Pretest	122	133	53	13	6.07
	Posttest	110	105	72	12	
5	Pretest	35	97	101	89	4.12
	Posttest	26	103	104	66	
6	Pretest	100	155	52	5	4.09
	Posttest	114	124	53	6	
7	Pretest	102	139	72	9	23.86*
	Posttest	130	137	28	4	
8	Pretest	222	97	6	2	3.89
	Posttest	214	75	6	6	
9	Pretest	83	126	119	16	7.63
	Posttest	34	114	141	10	
10	Pretest	12	119	153	30	5.43
	Posttest	10	98	145	46	
11	Pretest	142	133	33	16	1.99
	Posttest	126	113	32	22	
12	Pretest	113	133	51	29	5.53
	Posttest	86	145	44	18	
13	Pretest	45	113	118	40	1.06
	Posttest	50	105	102	36	
14	Pretest	116	178	23	5	3.06
	Posttest	114	145	30	4	
15	Pretest	30	85	162	36	4.75
	Posttest	20	102	143	30	
16	Pretest	85	115	87	31	2.79
	Posttest	78	112	85	18	

* - Significant at $p < .05$

While these were the only two questionnaire items for which there was a statistically significant change from pretest to posttest, the data for four statements are of interest; these are 6, 7, 8 and 14. For each of these items, there was a high percentage of agreement at both pretest and posttest.

For the 7th grade students (Table 5) who were enrolled in schools that participated in Project ICE, statistically significant differences were found between the ICE students and the Control students and/or statistically significant changes from pretest to posttest for thirteen of the sixteen questionnaire items. The three statements for which no statistical significance was found were 6, 11 and 16. For eight of the remaining items, there was a statistically significant difference between the responses of the ICE students and the Control students on the pretest; these were items 1, 2, 3, 5, 7, 10, 14 and 15. For these items, the interpretation of the change from pretest to posttest is puzzling. These items were carefully reviewed to possibly gain more insight as to why these differences occurred as well as to consider the possibility of non-comparable control schools.

Each of the questionnaire items for which statistical significance was found is discussed below:

Statement 1 - There was a statistically significant difference between the responses of the ICE students and the control students on the pretest with the ICE students having a greater percentage of disagreement. The ICE students also had a statistically significant change from pretest to posttest with the change being in the direction of greater disagreement with the statement. Thus, the data indicate that the ICE students felt more strongly at posttest that the standard of living cannot be increased without affecting the quality of the environment. The data for the students in the control schools indicate a similar pattern.

TABLE 5

Response Frequencies for the Grade 7
Environmental Questionnaire

Statement	Test/Group		Agree	Disagree	X^2
1	Pretest	Project ICE	459	683	13.12*
		Control	350	368	
	Posttest	Project ICE	360	705	6.94*
		Control	279	419	
	Project ICE	Pretest	459	683	9.64*
		Posttest	360	705	
	Control	Pretest	350	368	11.04*
		Posttest	279	419	
2	Pretest	Project ICE	722	419	25.02*
		Control	533	183	
	Posttest	Project ICE	628	533	7.57*
		Control	429	279	
	Project ICE	Pretest	722	419	20.02*
		Posttest	628	533	
	Control	Pretest	533	183	31.15*
		Posttest	429	279	
3	Pretest	Project ICE	922	222	10.55*
		Control	532	185	
	Posttest	Project ICE	950	210	2.35
		Control	577	153	
	Project ICE	Pretest	922	222	0.64
		Posttest	950	210	
	Control	Pretest	532	185	4.74*
		Posttest	577	153	
4	Pretest	Project ICE	808	334	0.02
		Control	506	212	
	Posttest	Project ICE	907	248	48.77*
		Control	557	225	
	Project ICE	Pretest	808	334	18.35*
		Posttest	907	248	
	Control	Pretest	506	212	4.68*
		Posttest	477	255	
5	Pretest	Project ICE	557	577	9.03*
		Control	403	313	
	Posttest	Project ICE	575	581	0.25
		Control	356	343	
	Project ICE	Pretest	557	577	0.09
		Posttest	575	581	
	Control	Pretest	403	313	4.08*
		Posttest	356	343	
6	Pretest	Project ICE	843	291	1.99
		Control	508	204	
	Posttest	Project ICE	856	292	3.28
		Control	495	205	
	Project ICE	Pretest	843	291	0.02
		Posttest	856	292	
	Control	Pretest	508	204	0.07
		Posttest	495	205	
7	Pretest	Project ICE	914	218	17.45*
		Control	517	197	
	Posttest	Project ICE	982	175	2.13
		Control	572	123	
	Project ICE	Pretest	914	218	6.87*
		Posttest	982	175	
	Control	Pretest	517	197	19.64*
		Posttest	572	123	
8	Pretest	Project ICE	1073	69	1.86
		Control	663	55	
	Posttest	Project ICE	1097	64	13.38*
		Control	637	71	
	Project ICE	Pretest	1073	69	0.30
		Posttest	1097	64	
	Control	Pretest	663	55	2.48
		Posttest	637	71	

TABLE 5
(Continued)

Statement	Test/Group		Agree	Disagree	X^2
9	Pretest	Project ICE	678	460	1.96
		Control	445	263	
	Posttest	Project ICE	733	418	13.95
		Control	377	310	
	Project ICE	Pretest	678	460	4.08*
		Posttest	733	418	
	Control	Pretest	445	263	9.17*
		Posttest	377	310	
10	Pretest	Project ICE	513	627	6.91*
		Control	368	350	
	Posttest	Project ICE	458	707	8.12*
		Control	324	380	
	Project ICE	Pretest	513	627	7.64*
		Posttest	458	707	
	Control	Pretest	368	350	3.89*
		Posttest	324	380	
11	Pretest	Project ICE	914	224	3.30
		Control	542	165	
	Posttest	Project ICE	902	254	1.12
		Control	529	168	
	Project ICE	Pretest	914	224	1.82
		Posttest	902	254	
	Control	Pretest	542	165	0.11
		Posttest	529	160	
12	Pretest	Project ICE	792	346	0.00
		Control	491	216	
	Posttest	Project ICE	841	305	4.30*
		Control	476	215	
	Project ICE	Pretest	792	346	4.02*
		Posttest	841	305	
	Control	Pretest	491	216	0.05
		Posttest	476	215	
13	Pretest	Project ICE	623	512	1.14
		Control	406	301	
	Posttest	Project ICE	591	549	0.30
		Control	343	336	
	Project ICE	Pretest	623	512	2.12
		Posttest	591	549	
	Control	Pretest	406	301	6.66*
		Posttest	343	336	
14	Pretest	Project ICE	978	151	16.34*
		Control	549	142	
	Posttest	Project ICE	989	154	1.97
		Control	573	108	
	Project ICE	Pretest	978	151	0.00
		Posttest	989	154	
	Control	Pretest	549	142	5.06*
		Posttest	573	108	
15	Pretest	Project ICE	595	535	37.39*
		Control	467	228	
	Posttest	Project ICE	455	675	6.24*
		Control	314	365	
	Project ICE	Pretest	595	535	34.87*
		Posttest	455	675	
	Control	Pretest	467	228	61.45*
		Posttest	314	365	
16	Pretest	Project ICE	839	285	0.72
		Control	510	190	
	Posttest	Project ICE	840	297	0.94
		Control	514	163	
	Project ICE	Pretest	839	285	0.17
		Posttest	840	297	
	Control	Pretest	510	190	1.70
		Posttest	514	163	

*Significant at $p < .05$

Statement 2 - The data indicate that there was a statistically significant difference between the responses of the ICE students and the control students on the pretest with the ICE students and having a greater percentage of disagreement. The ICE students also had a statistically significant change from pretest to posttest in the direction of greater disagreement with the statement. Thus, the data indicate that fewer of the ICE students believed at the posttest that the residents of Virginia Beach were concerned about local environmental problems. The data for the control students indicated a similar pattern.

Statement 3 - There was a statistically significant difference between the responses of the ICE students and the control students on the pretest with the ICE students having a greater percentage of agreement with the statement. For the ICE students, there was a non-significant change from pretest to posttest but there was a statistically significant change for the control students. While there was a high percentage of agreement among the ICE students that we need to discuss the use of the automobile at both pretest and posttest, the change for the control students was in the direction of greater agreement with the statement.

Statement 4 - The data indicate that there was a non-significant difference between the responses of the ICE students and the control students on the pretest. For both groups, there was a statistically significant change from pretest to posttest. However, the direction of the change was opposite for the two groups. While the responses of the ICE students indicated greater agreement with the statement that overpopulation is one of the greatest threats to the future of the country, the control students indicated lesser agreement at posttest than at pretest.

Statement 5 - The data indicate that there was a statistically significant difference between the responses of the ICE students and the control students on the pretest. Approximately 50 percent of the ICE students agreed with the statement while less than 50 percent of the control students agreed. While there was a non-significant change for the ICE students, there was a statistically change for the control students. The data indicate that at the posttest, more of the control students agreed with the statement at posttest with nearly 50 percent agreement.

Statement 7 - There was a statistically significant difference between the responses of the ICE students and the control students with the control students indicating a greater percentage of agreement with the statement. In addition, there was a statistically significant change from pretest to posttest for both groups. The direction of the change was the same for both groups; the change was in the direction of agreeing with the statement that the government should provide better mass transportation systems.

Statement 8 - The data indicate that there was a non-significant difference between the responses of the ICE students and the control students on the pretest but that there was a statistically significant difference on the posttest. However, for both the ICE students and the control students, there was a non-significant change from pretest to posttest. The data do indicate that the ICE students did have a slightly greater percentage agreeing to the statement on the posttest as compared to the pretest which the control students had a slightly lower percentage agreeing on the posttest. Even though these changes were non-significant individually, the combination of the two resulted in the significant difference between the two groups on the posttest.

Statement 9 - There was a non-significant difference between the responses of the ICE students and the control students on the pretest. For both groups, there was a significant change from pretest to posttest; however, the direction of the change was different from the two groups. For the ICE students, there was a change in the direction of agreeing with the statement that we must stop using herbicides and pesticides. On the other hand, a lesser percentage of the control students agreed with the statement on the posttest as compared to the pretest.

Statement 10- On the pretest, there was a statistically significant difference between the responses of the ICE students and the control students with a greater percentage of the ICE students disagreeing with the statement. It was interesting to note that for both groups, there was a statistically significant change from pretest to posttest. The direction of the change was that of further disagreement with the statement. This direction of change is of particular note for the ICE students. It would seem that these students would be more motivated to investigate environmental concerns as a result of their exposure to them through Project ICE. On the other hand, the additional information on the various topics could have been made available through the curricular units.

Statement 12 - The data indicate that there was a non-significant difference between the responses of the ICE students and the control students on the pretest but that there was a statistically difference between the responses of the two groups on the posttest. The difference between the two groups on the posttest can be attributed to the statistically significant change from pretest to posttest for the ICE students. For the ICE students, there was a greater percentage of agreement with the statement on the posttest indicating their understanding of how each individual is ultimately responsible for environmental pollution.

Statement 13 - On the pretest and the posttest, there was a non-significant difference between the responses of the ICE students and the control students. However, there was a statistically significant change from pretest to posttest for the control students. The data indicate that, on the posttest, a greater percentage of the control students disagreed with the statement that every high school student should be required to take a course in environmental studies. This result needs to be thoroughly reviewed by the project staff due to its potential implications for further curriculur offerings regarding environmental problems.

Statement 14 - There was a statistically significant difference between the responses of the ICE students and the control students on the pretest with a greater percentage of the ICE students in agreement with the statement. On the posttest, there was a non-significant difference between the two groups. This could be attributed to the fact that the control students had a statistically significant change from pretest to posttest while the ICE student had a non-significant change. For the control student, a greater percentage agreed with the statement on the posttest as compared to the pretest.

Statement 15 - The responses to this item are most puzzling. There was a statistically significant difference between the responses of the ICE students and the control students on both the pretest and posttest. In addition, there was a statistically significant change from pretest to posttest for both groups, there was a greater percentage of disagreement on the posttest.

The data for the 4th grade students (Table 6) indicated that there was a statistically significant difference between the ICE students and the Control students and/or statistically significant changes from pretest to posttest for twelve of the sixteen items. The four items for which no statistically sig-

TABLE 6

Response Frequencies for the Grade 4
Environmental Questionnaire

Statement	Test/Group		Agree	Disagree	X^2
1	Pretest	Project ICE	188	169	2.98
		Control	204	141	
	Posttest	Project ICE	155	256	9.77*
		Control	170	177	
	Project ICE	Pretest	188	169	17.27*
		Posttest	155	256	
	Control	Pretest	204	141	7.16*
		Posttest	170	177	
2	Pretest	Project ICE	284	71	0.75
		Control	266	78	
	Posttest	Project ICE	304	106	0.06
		Control	256	93	
	Project ICE	Pretest	284	71	3.67
		Posttest	304	106	
	Control	Pretest	266	78	1.47
		Posttest	256	93	
3	Pretest	Project ICE	198	159	1.97
		Control	210	136	
	Posttest	Project ICE	306	103	0.13
		Control	265	84	
	Project ICE	Pretest	198	159	31.73*
		Posttest	306	103	
	Control	Pretest	210	136	18.65
		Posttest	265	84	
4	Pretest	Project ICE	176	181	4.50*
		Control	143	203	
	Posttest	Project ICE	127	153	0.08
		Control	222	256	
	Project ICE	Pretest	176	181	0.98
		Posttest	127	153	
	Control	Pretest	143	203	2.13
		Posttest	222	256	
5	Pretest	Project ICE	192	166	0.25
		Control	179	167	
	Posttest	Project ICE	186	221	0.04
		Control	157	192	
	Project ICE	Pretest	192	166	4.79*
		Posttest	186	221	
	Control	Pretest	179	167	3.17
		Posttest	157	192	
6	Pretest	Project ICE	303	53	0.33
		Control	289	57	
	Posttest	Project ICE	362	46	0.04
		Control	308	41	
	Project ICE	Pretest	303	53	2.20
		Posttest	362	46	
	Control	Pretest	289	57	3.20
		Posttest	308	41	
7	Pretest	Project ICE	178	177	0.05
		Control	176	169	
	Posttest	Project ICE	259	147	12.00*
		Control	178	169	
	Project ICE	Pretest	178	177	14.44*
		Posttest	259	147	
	Control	Pretest	176	169	0.01
		Posttest	178	169	
8	Pretest	Project ICE	330	29	0.17
		Control	320	25	
	Posttest	Project ICE	386	24	0.05
		Control	329	19	
	Project ICE	Pretest	330	29	1.48
		Posttest	386	24	
	Control	Pretest	320	25	0.93
		Posttest	329	19	

TABLE 6
(Continued)

Statement	Test/Group		Agree	Disagree	X^2
9	Pretest	Project ICE	226	131	1.55
		Control	202	142	
	Posttest	Project ICE	274	134	3.90*
		Control	209	138	
	Project ICE	Pretest	226	131	1.25
		Posttest	274	134	
	Control	Pretest	202	142	0.16
		Posttest	209	138	
10	Pretest	Project ICE	298	58	2.61
		Control	270	72	
	Posttest	Project ICE	345	65	0.30
		Control	286	60	
	Project ICE	Pretest	298	58	0.03
		Posttest	345	65	
	Control	Pretest	270	72	1.53
		Posttest	286	60	
11	Pretest	Project ICE	189	169	12.87*
		Control	228	117	
	Posttest	Project ICE	235	174	4.55*
		Control	227	122	
	Project ICE	Pretest	189	169	1.68
		Posttest	235	174	
	Control	Pretest	228	117	0.08
		Posttest	227	122	
12	Pretest	Project ICE	245	114	0.20
		Control	230	115	
	Posttest	Project ICE	307	102	0.01
		Control	261	88	
	Project ICE	Pretest	245	114	4.39*
		Posttest	307	102	
	Control	Pretest	230	115	5.53*
		Posttest	261	88	
13	Pretest	Project ICE	297	60	0.11
		Control	291	55	
	Posttest	Project ICE	368	42	2.57
		Control	300	49	
	Project ICE	Pretest	297	60	7.13*
		Posttest	368	42	
	Control	Pretest	291	55	0.47
		Posttest	300	49	
14	Pretest	Project ICE	303	54	0.34
		Control	299	47	
	Posttest	Project ICE	371	37	1.27
		Control	306	40	
	Project ICE	Pretest	303	54	6.67
		Posttest	371	37	
	Control	Pretest	299	47	0.64
		Posttest	306	40	
15	Pretest	Project ICE	242	116	0.64
		Control	224	122	
	Posttest	Project ICE	218	189	2.21
		Control	204	142	
	Project ICE	Pretest	242	116	15.65*
		Posttest	218	189	
	Control	Pretest	224	122	2.45
		Posttest	204	142	
16	Pretest	Project ICE	247	111	6.85*
		Control	206	140	
	Posttest	Project ICE	323	85	2.89
		Control	255	90	
	Project ICE	Pretest	247	111	10.36*
		Posttest	323	85	
	Control	Pretest	206	140	16.08*
		Posttest	255	90	

*Significant at $p < .05$

nificant difference was found were 2, 6, 8, and 10. For three of the remaining twelve items, there was a statistically significant difference between the responses of the ICE students and the Control students on the pretest; these items were 4, 11, and 16. For these items, the interpretation of the change from pretest to posttest is also puzzling; therefore, each was carefully reviewed to gain insight as to why these differences occurred.

Each of the questionnaire items for which statistical significance was found is discussed below:

Statement 1 - There was a non-significant difference between the responses of the ICE students and the Control students on the pretest, but for both groups there was a statistically significant change from pretest to posttest. The data indicate that for both groups, there was a greater percentage who disagreed with the statement that we can have more of the things that we want without harming the environment.

Statement 3 - The data indicate that there was a non-significant difference between the responses of the ICE students and the Control students on both the pretest and the posttest. However, there was a statistically significant change from pretest to posttest for both groups. The direction of this change for both groups was in agreement with the statement that we should drive automobiles less often since they are a major source of pollution.

Statement 4 - There was a statistically significant difference between the responses of the ICE students and the Control students on the pretest but not on the posttest. In addition, there was a non-significant change from pretest to posttest for both groups.

Statement 5 - The data for this item indicate that there was a non-significant difference between the responses of the ICE students and the Control students on both the pretest and posttest. However, there was a statis-

tically significant change from pretest to posttest for the ICE students indicating that there was less agreement with the statement that everyone should pay for cleaning up the pollution caused by the utility companies.

Statement 7 - The data indicate that there was a non-significant difference between the responses of the ICE students and the Control students on the pretest but there was a statistically significant difference between the two groups on the posttest. This difference on the posttest can be attributed to the statistically significant change from pretest to posttest for the ICE students. The significant change for ICE students was in the direction of greater agreement with the statement that better public transportation should be provided rather than bigger and better highways.

Statement 9 - For this item, there was a statistically significant difference between the responses of the ICE students and the control students on the posttest but not on the pretest. This difference can be partially attributed to the slight difference on the pretest plus the slight change from pretest to posttest for the ICE students. These data indicate that the ICE students had a greater percentage of agreement with the statement that we should stop the use of insecticides to protect people and animals.

Statement 11 - The data indicate that there was a statistically significant difference between the responses of the ICE students and the Control students on both the pretest and the posttest. However, there was a non-significant change from pretest to posttest for both groups. For this item, the ICE students had a greater percentage of disagreement with the statement indicating that the amount of litter can be reduced if disposable bottles and cans are not used.

Statement 12 - There was a non-significant difference between the responses of the ICE students and the Control students on both the pretest and the posttest. For both groups, however, there was a statistically significant

change from pretest to posttest. The direction of the change was the same for both groups, that of a greater percentage of agreement with the statement that people cause pollution just as much as factories do.

Statements 13-15 - The results of the data analysis for these three items are the same. There was a non-significant difference in the responses of the ICE students and the Control students on both the pretest and the posttest, but a statistically significant change from pretest to posttest for the ICE students. For items #13 and #14, the change was in the direction of greater agreement with the statements that all elementary students should learn about the environment and that we should develop energy substitutes. However, on item #15, the direction of the change was of greater disagreement with the statement that they do not buy anything that harms the environment.

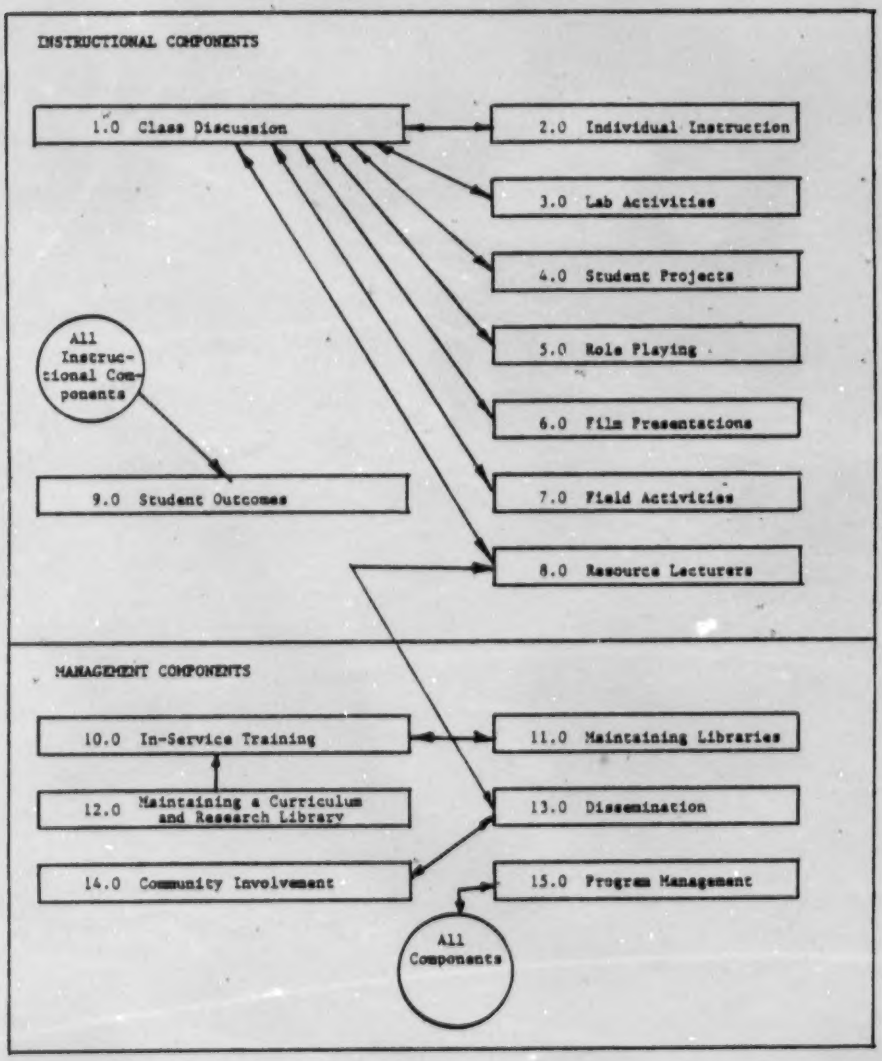
Statement 16 - The data indicate that there was a non-significant difference between the responses of the ICE students and the Control students on both the pretest and the posttest. Both groups had a statistically significant change from pretest to posttest. The discretion of the change was the same for both groups, namely, there was a greater percentage of agreement with the statement.

Instructional Activities

The various instructional components are outlined in the diagram illustrating the Program Components of Project ICE (Table 7); these instructional components are subsequently discussed. In an attempt to determine what percentage of the teachers' time was being spent in the various instructional activities, the teachers' were asked to estimate the percentage of time spent in each activity. A summary of these activities is found below. As can be seen, the majority of the time was spent in class discussion and laboratory activities.

TABLE 7

Program Components for Project ICE



	ACTIVITY	% OF TIME
1.	Class Discussion	25.6
2.	Simulations	10.0
3.	Lectures	13.3
4.	Guest Speakers	2.7
5.	Lab Activities	21.9
6.	Field Activities (trips)	8.1
7.	Audio Visual Activity (film/filmstrip)	14.1
8.	Other	4.3

In-Service Activities

Two major in-service activities for Project ICE staff were conducted during the 1978-79 school year; they were a workshop which was held on February 22, 1979 and a non-college credit course that was scheduled during the Spring. The agenda for the workshop and the course is as follows:

"Interdisciplinary Study of Environmental Science"

Environmental Education
Introduction
History
What are the Components of Environmental Education
Interdisciplinary Nature of Environmental Education
Activities
Lesson Assignment
Values Clarification
Games and Simulations
Local Resources
Other Resources
Preparation for Field Trip
Field Trip
Lesson Clarification
Tie-up of Field Trip
Evaluation Methods

The workshop was attended by 35 teachers, while 15 teachers and one principal attended the non-credit college class. An evaluation of the workshop was completed and the results are found in Table 8. As can be seen, the in-service program was received favorably by the majority of the teachers; especially, the individual sessions.

TABLE 8
EVALUATION OF THE ENVIRONMENTAL WORKSHOP
BY
PROJECT ICE TEACHERS

	Strongly Agree			Agree			Undecided			Disagree			Strongly Disagree		
	10th	7th	4th	10th	7th	4th	10th	7th	4th	10th	7th	4th	10th	7th	4th
General Session															
1. The program was presented in an interesting manner.		5	5	3	5	3			1	1		3			
2. The program was organized appropriately within the allotted time.		7	7	4	5	1						1			
3. The program was appropriate in light of current curricula trends.	1	9	6	3	3	2			1						
4. The material presented enhanced my knowledge of the subject.	1	5	6	2	6	2			1	1		1			
Individual Session															
1. There was opportunity to discuss problems or concerns within the new environmental program.	3	12	11	2	3	4									
2. The activities presented were appropriate to the new curriculum.	3	14	15	2	1										
3. The meeting was beneficial to me.	3	9	12	2	6	3									

PHASE THREE

While the data in the preceding sections of this report indicate the positive outcomes of Project ICE, several recommendations were made as the Project ICE staff planned for the third year of the project, as well as for the national validation effort. The recommendations are:

1. While the first year of Project ICE as a "teacher-oriented" year, the second year became a "student-oriented" year, that is, the evaluation of the project has primarily emphasized student outcomes. It is recommended that the "teacher-oriented" outcomes be continually emphasized including the continuation of the in-service activities as well as an extension of the project to include more teachers.
2. The curriculum guides were developed during the first year of Project ICE and were implemented and revised during the second year. It is recommended that, during the third year, an effort be made to evaluate the extent to which the various curricular units have been integrated into the science curriculum and as well as the effectiveness of these units.
3. The 10th grade achievement test was developed for administration in the Fall of 1978 and again in the Spring of 1979. The coefficients resulting from the KR-20 formula indicate moderate reliability (interval consistency). It is recommended that the test items be reviewed giving special attention to relationship between the test items and the objectives of the Ecology course. It is imperative that there needs to be a continued mapping of the test items onto the objectives. It is further recommended that the Grade 10 Content Test be increased from twenty to sixty items.
4. Attitude instruments were constructed for grades 4, 7 and 10 and were administered in the Fall of 1978 and again in the Spring of 1979. It is recommended that these instruments be reviewed giving careful consideration to the objectives of Project ICE for the respective grades. It is also

important to give consideration to the distinction between knowledge items and attitudinal items. As new items are developed, the readability levels need to be continually considered especially for grade 4.

5. As discussed in Student Attitude section of this report, significant differences were found between the responses of the ICE students and the control students. In the process of seeking validation for Project ICE, an experimental group/control group design has been deemed appropriate. Thus it is recommended that the project staff review possible reasons for the non-comparability of these groups on these items and make an effort to insure the comparability of the control group for grades 4 and 7.
6. The first student data were collected during the 1978-79 school year. These data were collected without giving consideration to a follow-up effort. Such a follow-up has been deemed appropriate for the validation effort. Thus it is recommended that when the achievement and attitude data are collected, a data record be established for each ICE student and for each control student that can be expanded to include additional data points in subsequent years. Such a data record will provide the ability not only to develop a profile for each student, but also, to analyze data for the various groupings of students over several years.
7. It is recommended that a more comprehensive energy unit be developed and implemented into the Project ICE curriculum.*

DISCUSSION AND CONCLUSION

Educational programs are usually successful if certain criteria are met. Those criteria which may be considered basic might be:

1. Trained personnel

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*All of the recommendations presented have been compiled with and implemented into the third year program.

2. Commitment by the personnel

3. Curriculum guides

4. Community involvement and assistance

5. Administrative support.

The validity of an environmental education program is directly related to the training of teachers in concepts and principals of environmental education. Consequently, a corps of trained personnel can provide the means to expand the knowledge within a system, and the expertise to develop needed curriculum guides and materials. With a market increasingly flooded with valuable teaching materials, it becomes imperative that trained personnel be used to edit, sort, and select materials, which would be of use within a particular system. Coordination of teacher training, in-servicing of teachers in schools where no resource teacher is located, and final purchase of curriculum materials is most effectively done by one individual. Continuity and progress toward program goals is best achieved when a program is adequately supervised.

The best educator of the adult population is, in all probability, the children. A more dramatic effect of a positive environmental education program is the education of tomorrow's voters. It is not enough to concentrate values training and decision making skills on the legislators, engineers and scientists. The key to a stable environment will lie with an educated and aware public who will support environmentally sound decisions.

FOOTNOTES

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2. U. S. News and World Report, November 27, 1978.

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